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Copper

By B. S. BUTLER

United States Geological Survey

THE copper industry is, and has long been, distinctly a world industry rather than a local or national one. Copper is produced in but comparatively few regions from which the supply is distributed to the peoples who are large users of the metal. Several of the highly industrial states are almost entirely dependent on outside sources, as Great Britain, France, Belgium and Holland, while others, like Germany, can supply but a portion of their needs. Other countries, like Chile and Peru, Mexico and the Belgian Congo, produce large amounts of copper and use but little, while others, like the United States and Canada, both consume and export large amounts. Figure 2 shows the relative production and consumption of the principal countries before the war.

United States.—Before the war the exports of copper from the United States exceeded 50 per cent of the total production and it is apparent that the industry in this country must meet the competition of a world market.

It is also apparent that, at present, North and South America are the greatest sources of supply, while the manufacture of copper is carried on largely in the United States and Europe.

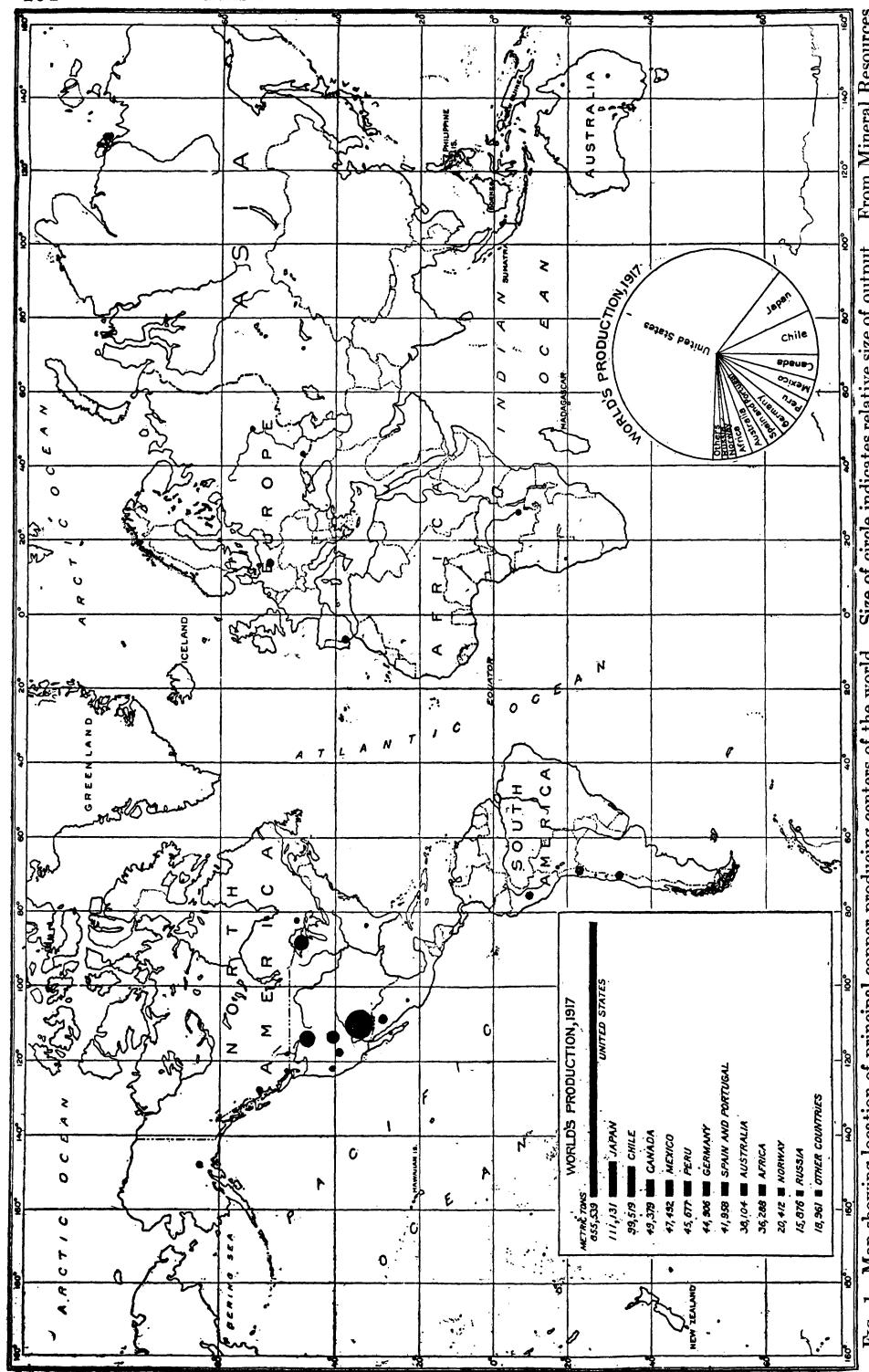
GROWING DEMAND FOR COPPER

The industry became important in the United States about 1845 with the development of the Lake Superior copper district. The rapid advancement

in production has been in response to the greatly increased need for machinery and electrical transmission—the two great uses of the metal. For these two uses no substitute has yet been found that is equal to copper in all respects. That there is bound to be a great expansion in both these uses seems obvious. The production of hydroelectric power is increasing throughout the world and the burning of coal at the mine and transmission of power is likely to make steady progress. It is perhaps not too much of a dream to picture, at no very distant date, an interlocking power system that shall cover the eastern part of our country, for example, utilizing the available water power and supplementing this power by coal. This system will furnish power for traction, manufacturing, light and heat. As oil begins to fail, as the geologists tell us it soon will, the motorist of the future may stop at the service station for "juice" instead of "gas." If development lies in the direction suggested, within the next score of years we may see quite as intensive a campaign to develop copper mines as we are now witnessing in the search for oil. In fact, the large exploration companies already foresee a great future demand and are acquiring territory that has promise of yielding copper wherever it is to be found.

War Demand for Copper

In the past the output of copper has been controlled by the demand. For



several years before the war the capacity of copper mines was in excess of the demand for copper and the increase in the capacity of metallurgical plants had been guided by the probable need for the metal. Thus, until they were hampered by shortage of labor the mines were easily able to meet the unusual demands caused by the war. But it required some time to bring the metallurgical plants up to the same capacity. The increased need for copper for war purposes was proportionately greater than for most of the

major metals, thus, as compared with iron, it shows the following ratio: For the period of 1880 to 1885 there was produced in the world one ton of copper to 104 tons of iron; for the period 1911 to 1915 the ratio was 1 to 70; in 1913 the ratio was 1 to 79; in 1914, 1 to 66; in 1915, 1 to 61; in 1916, 1 to 53; in 1917, 1 to 52; and in 1918, 1 to 54. This war demand has tended to develop an excess of copper-producing capacity over that required for peace times, a condition which is emphasized by the fact that a much

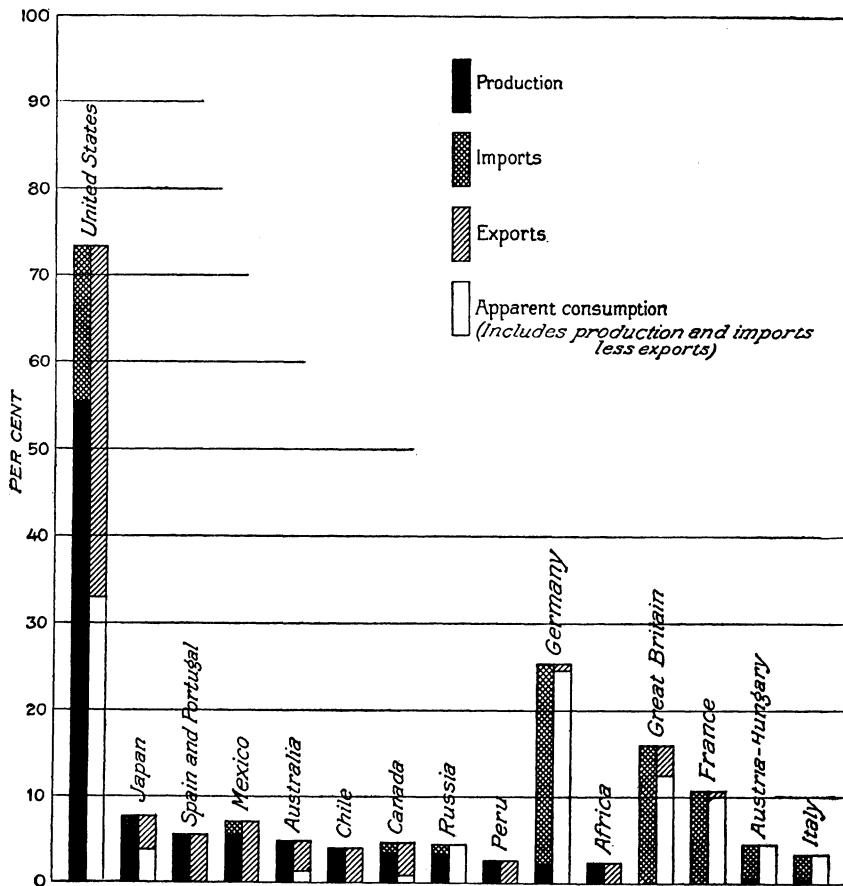


FIG. 2.—Relative production, consumption, imports, and exports of copper by the principal copper producing and consuming countries in 1913. From Mineral Resources of U. S. 1917, U. S. Geological Survey.

larger proportion of copper than of iron that has entered into war uses can be converted into peace-time uses. Furthermore, so far as the United States is concerned the slow recovery of European countries from war conditions and the severe drop in the rate of exchange has hampered export business. There was, however, a steady increase in the amount of copper used for peace-time industry as compared with iron before the war and the temporary unbalancing of the ratio by the war will doubtless soon disappear.

WAGES AND COPPER PRICES

For several years before the war, wages in the copper industry, and in fact in the mining industry in general in the western United States, were controlled by the price of copper. In several of the large copper-producing camps there were agreements whereby wages should automatically rise and fall in an agreed ratio, with the rise and fall of the selling price of copper. This system was also generally followed even where there was no formal agreement, and other classes of mining in the west found it necessary to meet the wage of copper miners in order to hold their best class of labor. When the price of copper rose to unusual levels during war and the producing companies were making very large profits, there was a demand on the part of labor for a larger participation in the prosperity. This demand was met by giving bonuses above the price that was indicated by the earlier agreements. When the price was fixed at 23.5 cents a pound in September, 1917, by agreement between the producers and the government, it was stipulated that wages should not be

reduced and from that time there has been no close relation between the price of copper and wages in the sense of the pre-war agreements. After the close of the war, when the price of copper fell, it was found that the high cost of living made it impractical to return to the pre-war schedule, and in places where wages were greatly reduced it was found necessary to again raise them in order to hold a desirable class of labor.

Before the war the copper mining industry had been in a prosperous condition. The average cost of producing copper for the years immediately preceding the war was probably 9 to 10 cents per pound and the average selling price for the years 1909 to 1913 was about 14 cents a pound. The average profit was therefore 4 to 5 cents a pound, or 40 to 50 per cent of the cost of production.

Shortly after the opening of the European war, the price of copper advanced rapidly from 13.3 cents a pound in 1914, to 17.5 cents in 1915, 24.6 cents in 1916, and 27.3 cents in 1917. The cost of production also advanced, but not as rapidly. In 1918, as determined by the Federal Trade Commission, the average cost of producing copper for 85 companies, including foreign production of over 400,000,000 pounds, was 16.167 cents a pound. The average cost in 1917 was doubtless somewhat less. It would appear, then, that in 1917 the profit per pound had risen to 12 and 13 cents and that the ratio of cost to profit did not differ greatly from the pre-war ratio. After the fixing of the price there was a decrease in the profits and in the ratio of costs to profits and a further decrease following the close of the war when the

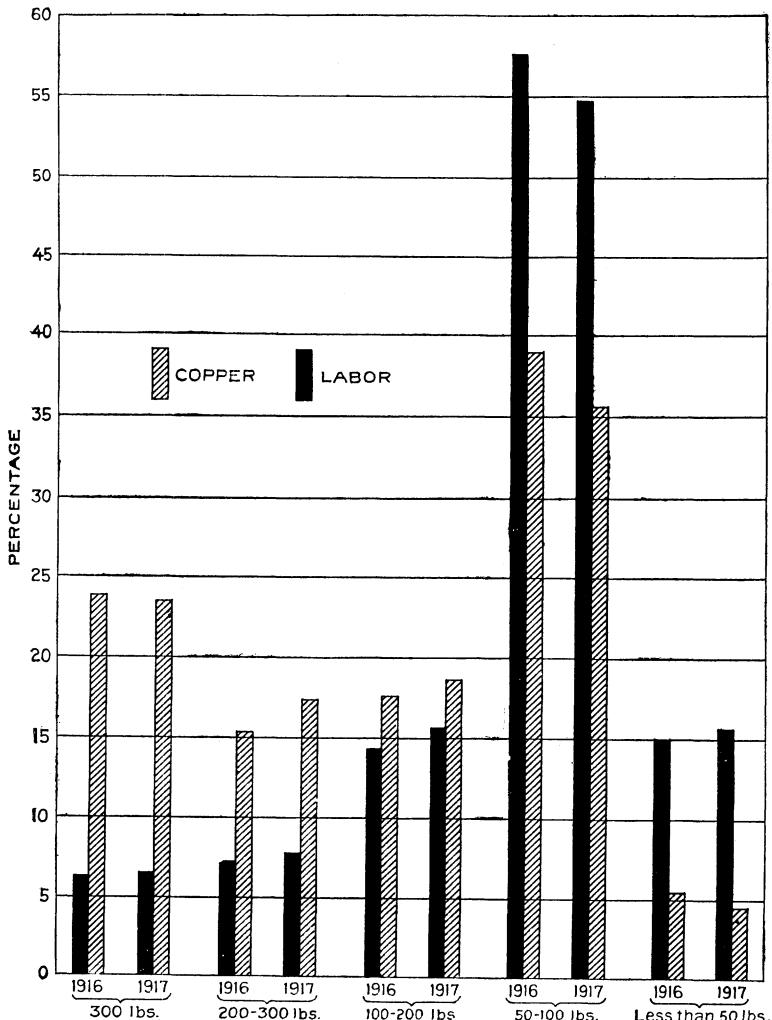


FIG. 3—Labor employed and copper produced in different classes of copper mines, 1916 and 1917.
From Mineral Resources of the U. S. 1917, U. S. Geological Survey.

selling price fell. There was a decrease in costs due to increased efficiency of labor and the closing of mines where the costs were high, but there was undoubtedly a great decrease in profits, a condition which has continued to the present.

EFFICIENCY IN COPPER MINING

The increase in the amount of copper that has resulted from a day's

labor is a notable and gratifying feature of the copper industry. Thus, in the five-year period from 1912 to 1916 the average amount of copper mined per man per day increased from 75 to 100 pounds. This does not include labor for transportation and metallurgical treatment. An increase of 20 per cent in days worked per year produced an increase of 62 per cent in copper mined. This increase is due largely to improve-

ment in machinery and in methods of mining and especially to the increased proportion of copper derived from large deposits that are operated cheaply on a large scale.

In this connection, it is of interest to note the very great difference of labor efficiency in different mines. Figure 3 and Table I show the proportion of copper mined in the United States act different rates of labor efficiency, for the years 1916 and 1917.

of labor in the years 1916 and 1917, is worthy of note.

In the early years of the war, when there was no marked shortage of labor, an increased price greatly stimulated production, but in the later years when there was an acute labor shortage the high price that permitted the operation of inefficient mines and left the more efficient mines short of men doubtless tended to reduce production, which did not increase after our entry

TABLE I
Classification of copper mines according to efficiency of labor in mining

Mine production (pounds per man per day)	Percentage of total labor employed		Percentage of total copper produced by mines		Average production per man per day	
	1916	1917	1916	1917	1916	1917
Above 300.....	6.2	6.4	22.5	22.5	Pounds 416.1	Pounds 371.8
200 to 300.....	7.2	7.7	14.2	16.5	230.0	227.9
100 to 200.....	14.2	15.6	16.2	17.7	133.3	120.5
75 to 100.....	39.0	6.5	26.6	5.5	78.9	90.5
50 to 75.....	18.4	48.2	9.5	30.1	59.6	65.1
Less than 50.....	15.0	15.5	5.0	4.4	38.5	30.1
By-product and labor efficiency unknown.....	.....	.....	94.0	96.7	108.9	102.2
			6.0	3.3	.....	.....
			100.0	100.0	.....	.....

Table II shows the copper output of the country classified by the size of output of the mines.

The most striking feature of this table is the large increase in the number of small mines from 1913 to 1916 and 1917 without a correspondingly large increase in the copper produced. On the other hand, the large mines showed but a moderate increase in number, but from 1913 to 1916 a very large increase in the production of copper. The effect of the high price of copper, combined with the shortage

into the war. It would seem that in a crisis like the war, we cannot rely explicitly on an increase in price of a commodity to bring an increased production; and that in a commodity like copper, where there was but a limited supply of labor that could be fairly assigned to that industry, it is the part of wisdom to employ it in the most efficient mines, rather than to encourage prospecting and inefficient mining by making the price so high that such operations can be carried on profitably.

TABLE II

Copper output of the United States 1913, 1916, and 1917, classified by mines in which copper was the most important constituent and by those in which it was a by-product, and the production of the copper mines classified according to their contribution to the total output.

Year	Production from copper mines producing—							
	Less than 1,000,000 pounds		1,000,000 and less than 5,000,000 pounds		5,000,000 and less than 10,000,000 pounds		10,000,000 pounds or more	
	Number of mines	Quantity (pounds)	Number of mines	Quantity (pounds)	Number of mines	Quantity (pounds)	Number of mines	Quantity (pounds)
1913....	492	22,960,797	36	93,089,952	11	78,178,256	24	1,004,634,383
1916....	914	50,497,875	55	131,708,061	12	92,125,118	30	1,703,393,730
1917....	1,006	50,641,988	58	130,596,600	16	106,458,988	32	1,579,590,348

Year	Total		Copper by-product		Grand total		Average price of copper (cents per pounds)
	Number of mines	Quantity (pounds)	Number of mines	Quantity (pounds)	Number of mines	Quantity (pounds)	
1913....	563	1,198,862,388	883	36,707,339	1,446	1,235,569,727	15.5
1916....	1,011	1,977,724,784	837	28,150,528	1,848	2,005,875,312	24.6
1917....	1,112	1,867,287,924	813	28,146,425	1,925	1,895,434,349	27.3

Whether or not the price fixed in 1917 met the ideal of employing all available labor without encouraging its inefficient use, may be open to question. It certainly tended to dis-

courage operation of very inefficient mines. On the other hand, it was criticized for not allowing the same proportionate rise in price to copper that was being received by other commodi-

TABLE III

Year	General index number	Price per pound of copper calculated from general index	Average actual price per pound received for copper
1910....	99	13.95	12.7
1911....	97	13.67	12.5
1912....	101	14.24	16.5
1913....	102	14.38	15.5
1914....	101	14.24	13.3
1915....	102	14.38	17.5
1916....	125	17.63	24.6
1917....	178	25.10	27.3

ties. The amount of this difference is indicated in Table III. The general index prepared by the United States Department of Labor is presented and compared with copper. The base is the average of the five-year period 1910 to 1914.

It is apparent that during the period

1915 to 1917 the price of copper was high relative to the general advance in commodities. It is also apparent that the price agreed upon between the copper producers and the government was considerably below the figure that is indicated by the general advance in commodities.